

**SECTION 16700
CONTROL/SIGNAL TRANSMISSION MEDIA**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of control and signal transmission media:
 - 1. Coaxial cable.
 - 2. Twisted-pair cable.
 - 3. Video-pair cable.
 - 4. Optical fiber cable.
 - 5. Optical fiber connectors and couplers.
 - 6. Data Highway (Blue Hose) Cable
- B. Related Sections include the following:
 - 1. Section 16050, Basic Electrical Materials and Methods" for building wire used for control or signal circuits.
 - 2. Division 07, Firestopping.
 - 3. Section 16196, Electrical Identification.
 - 4. Section 16129, Fiber Optic Cable and Accessories for Data Communications.

1.3 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70-1999, National Electrical Code (NEC).
- B. Underwriters Laboratories, Inc. (UL):
 - 1. UL 486A, 1997, Wire Connectors and Soldering Lugs for Use With Copper Conductors.
 - 2. UL 486B, 1997, Wire Connectors for Aluminum Conductors.
 - 3. UL 910, Plenum Rated Cables
- C. Military Specifications:
 - 1. MIL-C-17 Specifications or Cable, Radio-Frequency, Coaxial.
- D. International Electrical Testing Association:
 - 1. NETA ATS-1995, Electrical Testing Specifications.

1.4 SUBMITTALS

- A. Product Data: For control/signal transmission media.
- B. Product Certificates: Signed by manufacturers of transmission media certifying that the products furnished comply with requirements and that they have been coordinated with and accepted by manufacturer of connected equipment.
- C. Submit samples of each of the following cable types for approval:
 - 1. Optical fiber riser cables.
 - 2. Composite copper and optical fiber cables.

- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Maintenance Data: Maintenance manuals for transmission media as specified in General and Supplementary Conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain all cable of each type through one source from a single manufacturer.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate with and obtain review of cable characteristics and certification for use with the connected system's equipment by the connected equipment manufacturers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Electronic Cables:
 - a. American Insulated Wire Corp.
 - b. AT&T Technology, Inc.; Cable and Wire Division.
 - c. Berk-Tek, Inc.
 - d. BICC Brand-Rex Company.
 - e. Cooper Industries; Belden Division.
 - f. Guardian Products; General Cable.
 - g. Mohawk Wire and Cable Corp.
 - h. Pirelli Cable Corp.; Power Cable Division.
 - i. Belden Wire and Cable Company
 - j. Commscope Properties, LLC
 - 2. Optical Fiber Cables:
 - a. AT&T Technology, Inc.; Cable and Wire Division.
 - b. BICC Brand-Rex Company.
 - c. Cooper Industries; Belden Division.
 - d. Mohawk Wire and Cable Corp.
 - e. Optical Cable Corp.
 - f. Pirelli Cable Corp.; Power Cable Division.
 - g. Siecor Corp.

2.2 ELECTRONIC CABLE

- A. Single-Conductor Coaxial: 50-ohm characteristic impedance, cellular polyethylene core, 97 percent coverage, bare copper-braid shield, PVC jacket; complying with MIL-C-17, Type RG-58/U.
- B. Single-Conductor Coaxial: 75-ohm characteristic impedance, solid polyethylene core, 97 percent coverage, copper-braid shield, polyethylene jacket; complying with MIL-C-17, Type RG-6A/U.
- C. Single-Conductor Plenum Coaxial: 75-ohm characteristic impedance; solid bare copper central conductor; foamed PTFE dielectric, 100 percent coverage tinned-copper, double-braid shield; PTFE jacket; suitable for installation in air-handling spaces; complying with MIL-C-17, Type RG-11/U.
- D. Multiconductor Cable: Quantity of conductors indicated; No. 18 AWG tinned-copper conductors; color-coded, low-loss PVC insulation; aluminum/Mylar shield; No. 22 AWG tinned-copper drain wire; PVC jacket.
- E. Twisted Pair: Single twisted pair of No. 22 AWG tinned-copper conductors; color-coded, low-loss polyethylene insulation; unshielded.
- F. Twisted Pair: Quantity of twisted pairs indicated; No. 22 AWG tinned-copper conductors; color-coded, low-loss polyethylene insulation; unshielded PVC jacket.
- G. Twisted Pair: Quantity of twisted pairs indicated; No. 22 AWG tinned-copper conductors; color-coded, PVC insulation; overall aluminum/polyester shield; No. 22 AWG tinned-copper drain wire; PVC jacket.
- H. Twisted-Pair Plenum: Quantity of twisted pairs indicated; No. 24 AWG, 7-strand, tinned-copper conductors; PTFE insulation; overall aluminum/polyester shield; No. 22 AWG tinned-copper drain wire; PTFE jacket; suitable for use in air-handling spaces.
- I. Video Pair: Balanced-pair coaxial cable; 125-ohm characteristic impedance; No. 16 AWG soft-drawn, bare copper conductors twisted to form pairs; expanded-polyethylene core insulation; copper shielding tape; expanded-polyester film covering.
- J. ControlNet Cable for use in cable tray: Description: RG-6/U type, riser rated, for indoor use, 18 AWG solid copper covered steel conductor, foamed polyethylene insulation, nominal OD 0.298 in., nominal 75 ohm impedance, quad shield, PVC jacket. Belden 3092A, or equal.
- K. ControlNet Cable for use in ductbank: RG-6/U type, water proof for flooded or buried installation, 18 AWG solid copper covered steel conductor, cellular high density polyethylene insulation, nominal OD 0.295 in, nominal 75 ohm impedance, quad shield, polyethylene jacket. Belden 1190A, or equal.
- L. DeviceNet Trunk: 2 twisted pairs, overall mylar shield and braided shield, power pair # 15 AWG, data pair #18 AWG, CPE jacket, OD 0.480 in., tray rated, water resistant. Belden 3083A, or equal.
- M. Data Highway (Blue Hose) Cable: 20 AWG twinaxial cable, stranded TC, shielded with PVC jacket. Commscope #9022, or approved equal.

2.3 OPTICAL FIBER CABLES AND CONNECTORS

- A. Cables: Factory-fabricated, single-channel, low-loss, glass-type, optical fiber, multimode, graded-index cables.
- B. Construction: Single fiber with a 50-micron or 62.5-micron core diameter and a 125-micron cladding diameter; 250-micron outside-jacket diameter.
- C. Ratings: 4.0-dB/850-nm maximum attenuation, 400-MHz/km minimum bandwidth, 0.2 nominal numerical aperture.
- D. Physical Characteristics: 7.5-kg/km, 500-N maximum installation load, 150-N maximum operational load, 30-mm minimum bending radius.
- E. Operating Temperature Range: Minus 20 to 70 deg C.
- F. Optical Fiber Connectors: Stainless-steel optical fiber cable connectors, capable of terminating optical fiber glass cables, with diameters ranging from 125 to 1,000 microns. Fabricate connectors with optical fiber, self-centering, axial alignment mechanisms. Select resilient tip SC-type connectors with quick-connect features and with insertion loss of not greater than 1.0 dB.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and other elements to receive cables for compliance with requirements for installation tolerances and other conditions affecting performance of transmission media. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Control/Signal electronic cables in all areas, buildings, spaces, etc. shall use the insulation materials listed in this section. Teflon or nylon jacketed cables may be used.

3.3 INSTALLATION

- A. Install cable as indicated, according to manufacturer's written instructions.
- B. Install transmission media without damaging conductors, shield, or jacket.
 - 1. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.
- C. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
 - 1. Pull cables simultaneously if more than one is being installed in same raceway.
 - 2. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
 - 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage media or raceway.
 - 4. Use a scale to measure the pulling tension of the TPS cables.
- D. Install exposed cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.
- E. Support cables according to Section 16050, "Basic Electrical Materials and Methods."

- F. Use splice and tap connectors compatible with cable material.
 - 1. Make no splices except at indicated splice points.
- G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."
- H. Bond shields and drain conductors to ground at only one point in each circuit.
- I. Connect components to wiring system and to ground as indicated and instructed by manufacturer.
- J. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- K. Identify cables according to Section 16196, "Electrical Identification."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.
- B. Copper Cable Testing Procedures: Inspect for physical damage and test cable for continuity and shorts. Use time-domain reflectometer with strip-chart recording capability and anomaly resolution to within 12 inches (300 mm) in runs up to 1,000 feet (300 m) in length. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.
- C. Optical Fiber Cable Testing Procedures: Perform each visual and mechanical inspection and field test, including optional procedures, stated in NETA ATS, Section 7.25. Certify compliance with test parameters and manufacturer's written instructions.
- D. Replace malfunctioning cables at Project site, where possible, and retest to demonstrate compliance.
- E. Notify SNS QA department prior to installation of TPS conduit and cables identified in the Target Protection System Cable Schedule. SNS will provide a QA person to document the TPS installation.

END OF SECTION 16700